Summary from last time

- Template Model:
  - Imagistic/holistic representations
  - Viewer-centered (templates for multiple views
- Simple Feature Model:
  - Symbolic representations (of visual information – any type of features)
  - Viewer-centered
- Structural/Geon Model:
  - Shape and spatial relations
  - Object-centered

Thought Question

Imagine that you discover a group of patients who seem to have selectively lost the ability to recognize objects presented in “unusual” views. Their identification of objects presented in more typical views appears unchanged. Which models of object recognition is this observation consistent with? With which models is this inconsistent?

Faces

What is special about faces?

- Carry important social information (and always have).
- Visually very similar: same parts and same configuration.
- Yet generally must be identified at an *individual* level.

Disorders of face processing

Prosopagnosia

- Specific inability to recognize familiar faces.

- Patients unimpaired with other objects.
- Patients know when they are looking at a face, but cannot say whose face it is.

What this disorder reveals:

Face processing . . .

- can be *dissociated* from the processing of other visual objects.
- happens at multiple processing levels.
  - “That’s a face” (similar to other objects)
  - “That’s my Psych 224 instructor” (different from other objects).

Familiar (or Famous) Faces

Do you recognise this person?

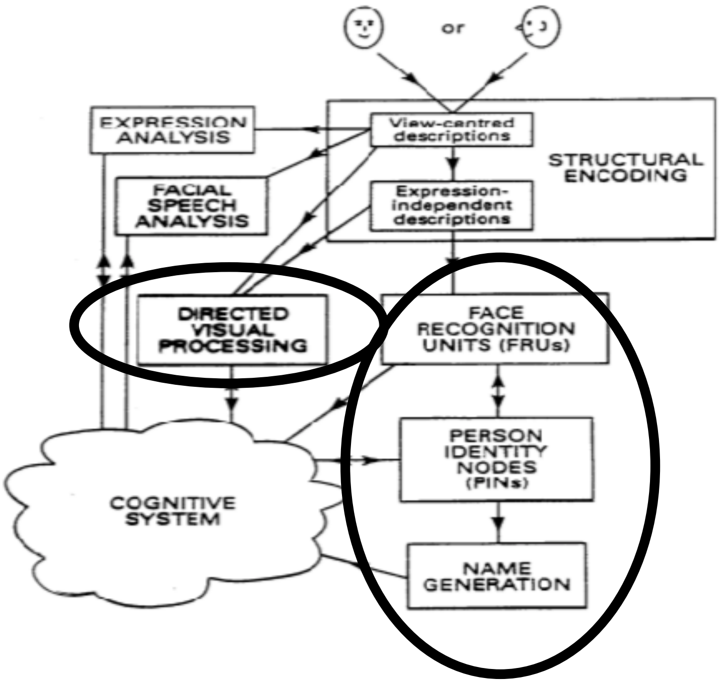
Where do you know her from?

What is her name?

Knowledge associated with faces

- At least **three** types of knowledge are accessed during the identification of ***familiar*** faces.
    - 1) Recognizing the face as ***familiar***.
    - 2) Retrieving stored ***biographical knowledge***.
    - 3) Retrieving the ***name of the person***.
- Traditional (IP) models assume that these are accessed during separate stages of processing.

Bruce and Young (1986)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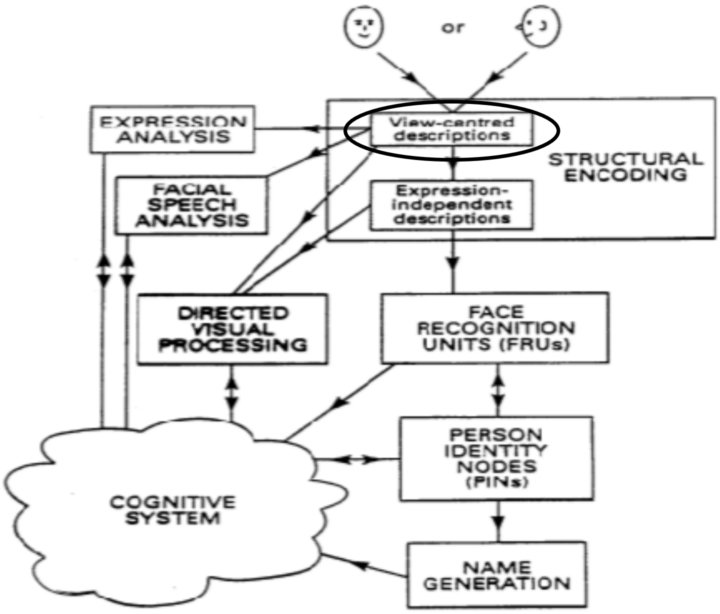
COGNITIVE SYSTEM
NAME GENERATION

Bruce and Young (1986)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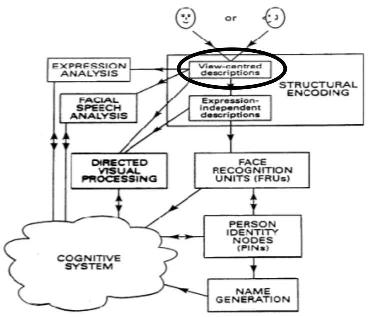
(1) Viewer-centered

- Model assumes a *viewer-centered* description of a face. Why?
- ➢ Experiments show that people respond differently to:
  - full face views

  - 3/4 views

  - profiles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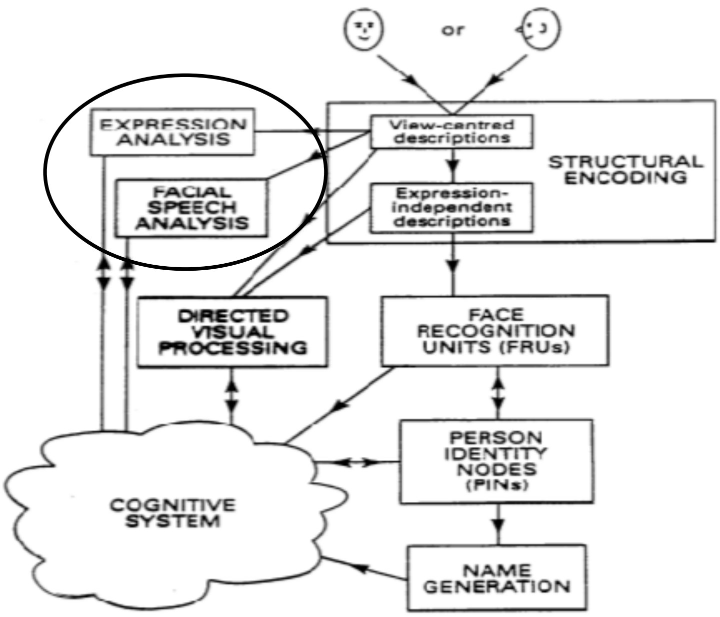
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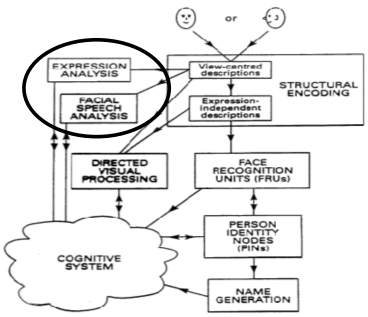
Sidebar: Expression/Speech Analysis



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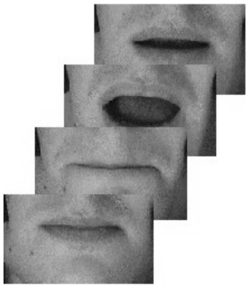
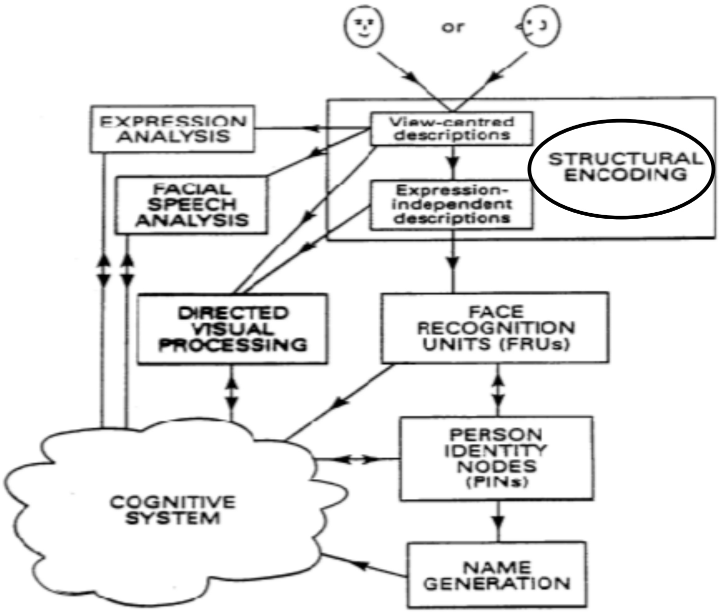
- Even for unfamiliar faces, can:
  - examine expressions to determine emotion.

  - examine movement to help analyze speech.



Bruce and Young (1986)



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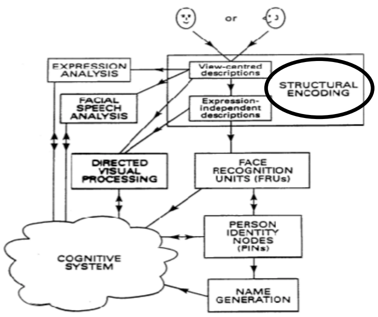
(2) Structural encoding

- Need to create a description of the face that is useful for recognition.
- Specific features might help.
- But more often have to analyze *configuration* of a face.
  - relations between parts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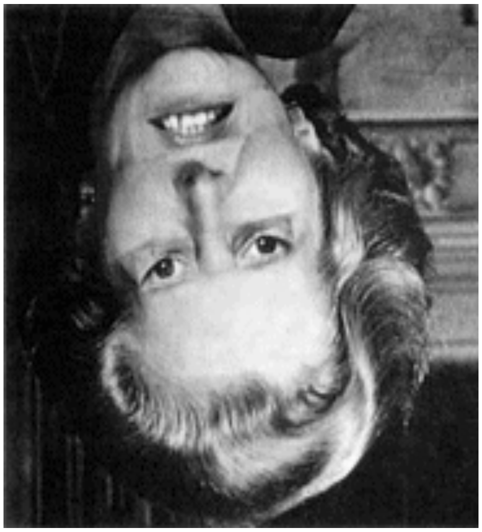
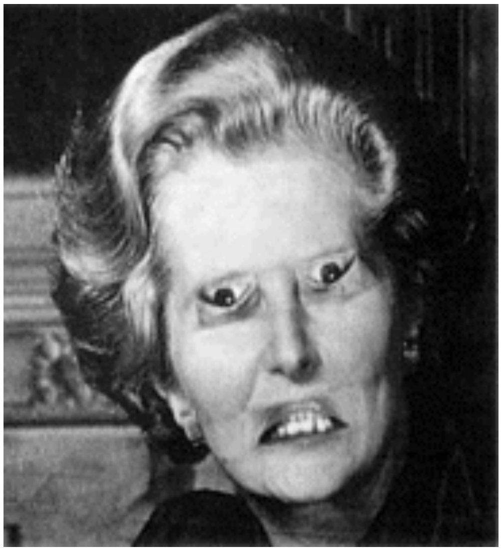
Importance of configuration



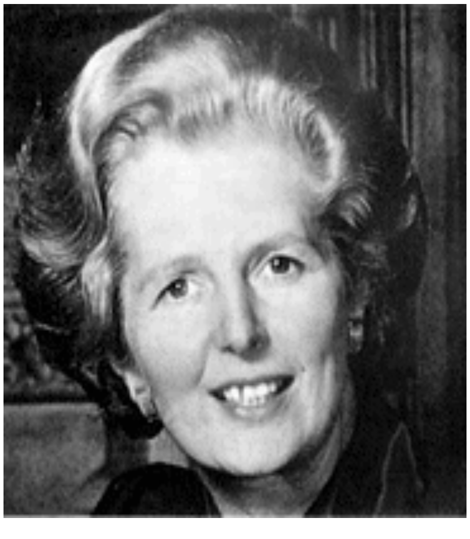
Importance of configuration



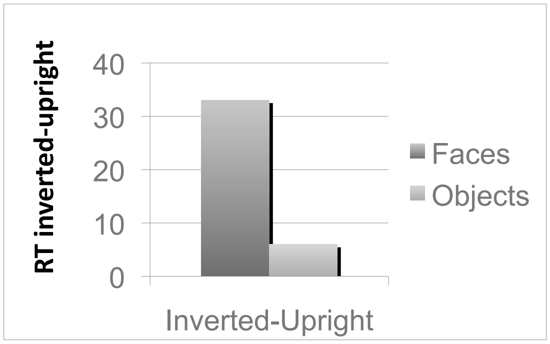
Importance of configuration

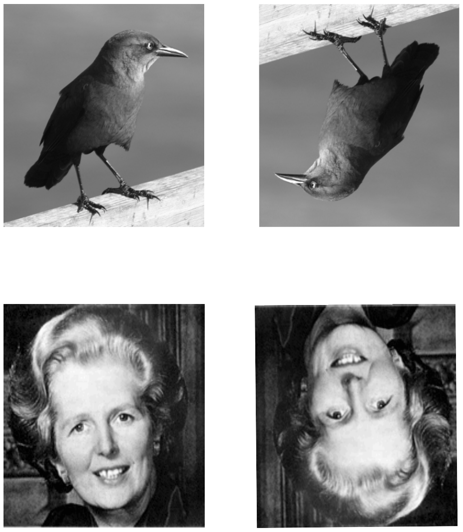
“Inversion effect”

Much stronger for faces than for other types of objects.



Importance of configuration



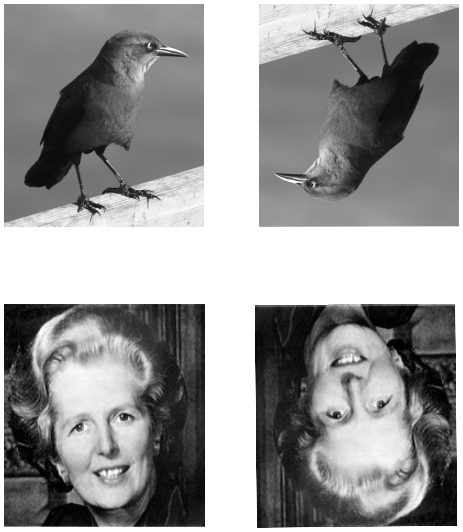


Importance of configuration

Processing individual features is not much harder for upside-down than for rightside-up objects.

But analyzing the configuration is totally changed, and we are used to doing that from a particular view.

Thus, the inversion effect points to configural processing.

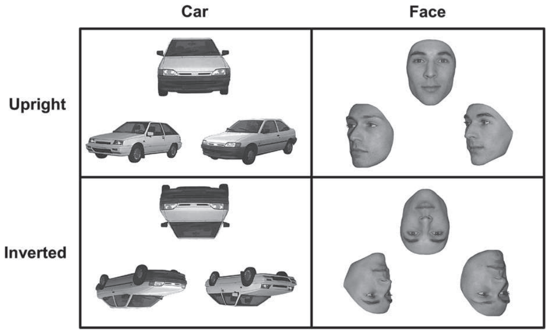


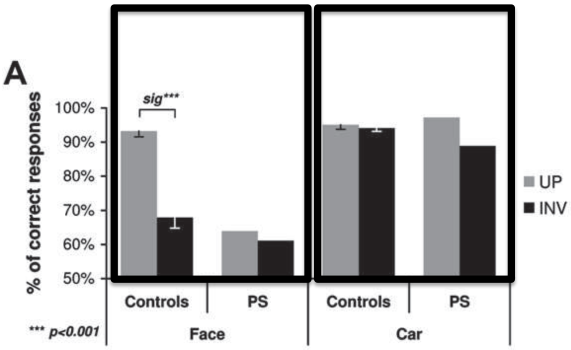
Prosopagnosia & Inversion

- If the inversion effect shows that faces are special, do individuals with prosopagnosia show face inversion effects?
  - Some evidence suggests **that prosopagnosia eliminates the face-inversion effect….**

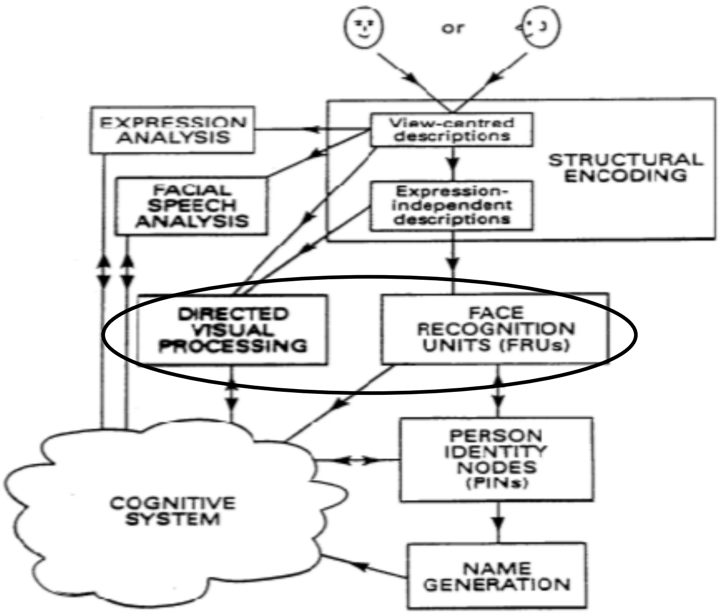
Busigny & Rossion (2010)

- Compare prosopagnosia patient **PS** with healthy controls





Bruce and Young (1986)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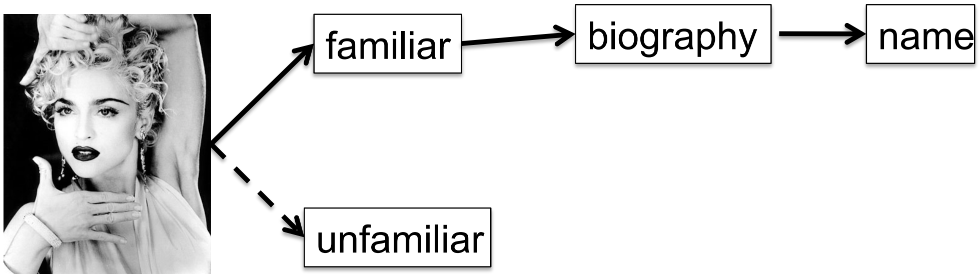
IP model of face processing



familiar

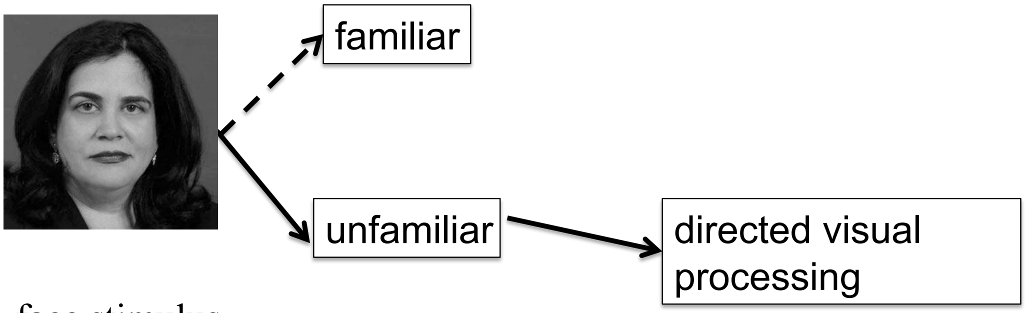
biography

name

unfamiliar

face stimulus

IP model of face processing


familiar

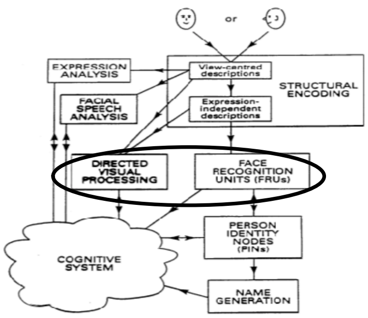
unfamiliar

directed visual processing

face stimulus

(3) Two main pathways

- The processing of familiar and unfamiliar faces diverges after structural encoding.
  - recognize
  - “directed visual processing” (e.g., look more carefully)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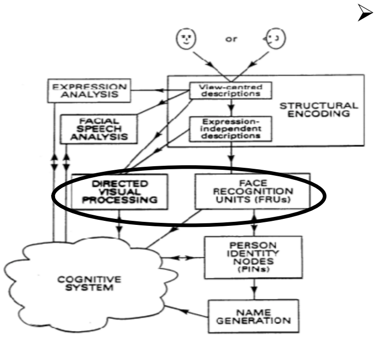
What does this predict?

Double dissociation

- If *different* functions underlie the processing of familiar and unfamiliar faces, should be able to find patients who are selectively impaired on each.
  - Can find patients who can match unfamiliar faces but can't recognize famous ones.
  - Can find patients who can recognize famous faces but can't match unfamiliar ones.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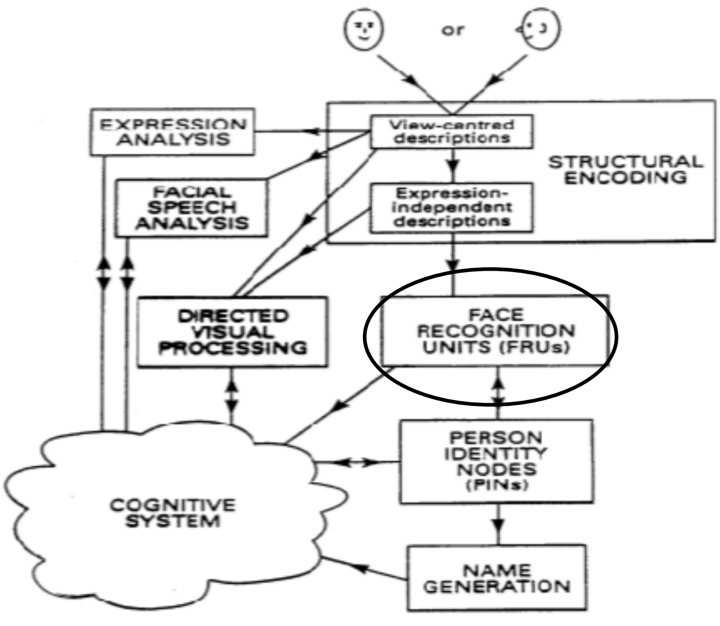
Bruce and Young (1986)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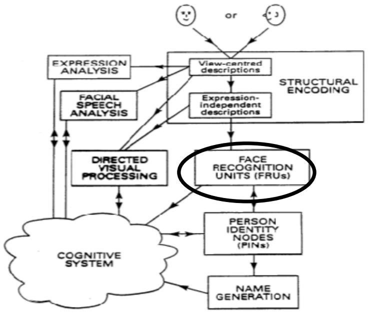
(4) Face recognition units

- For familiar faces, first step is to recognize *that* the face is familiar.
  - Note that this need not have been a separate step.
- What does this predict?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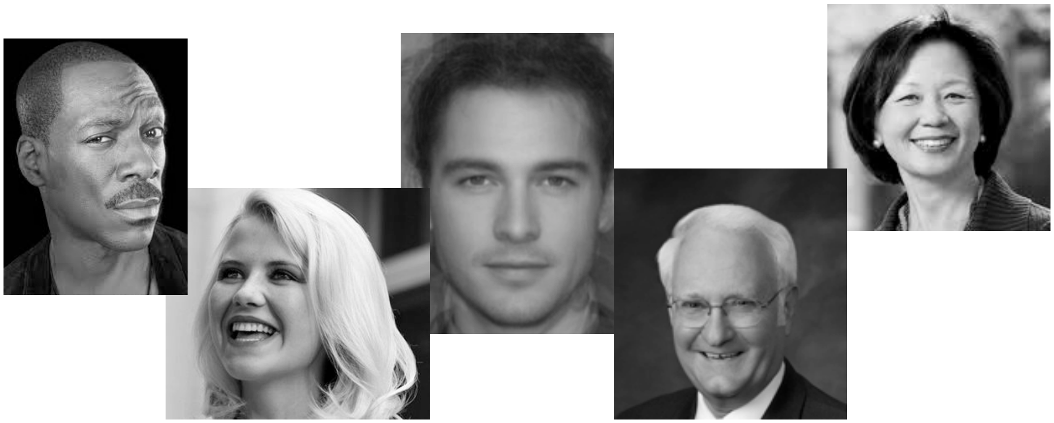
Expected behaviors

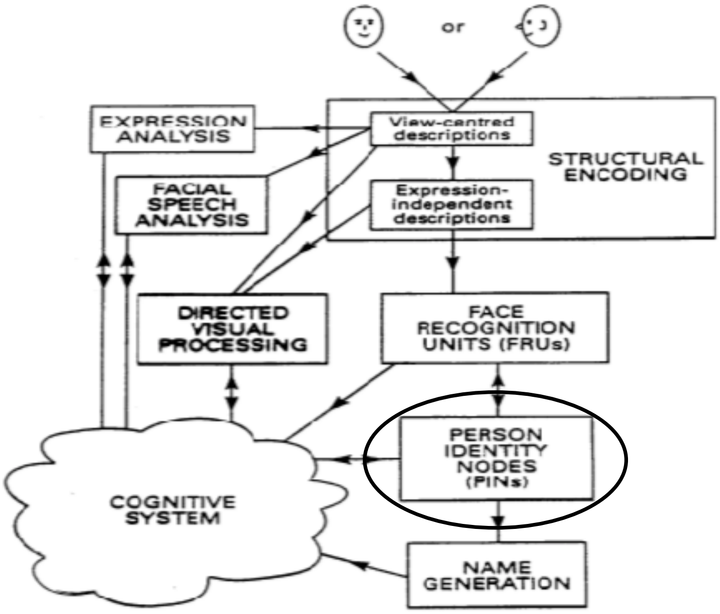
- Should find cases where people know a face is familiar, but don’t know anything else . . .
  - Diary studies: people report cases like this.
  - Reaction times are faster for familiarity decisions than occupation decisions.

Familiar Faces

- For each face, decide if it is familiar or not. If it's familiar, do you know anything about them (name, where you know him/her from)?



Bruce and Young (1986)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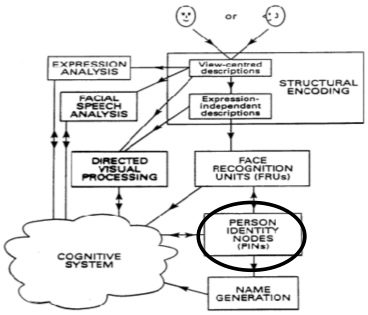
(5) Person identity nodes

- Once face is recognized, access biographical information.
- Note that this does NOT include the person's name.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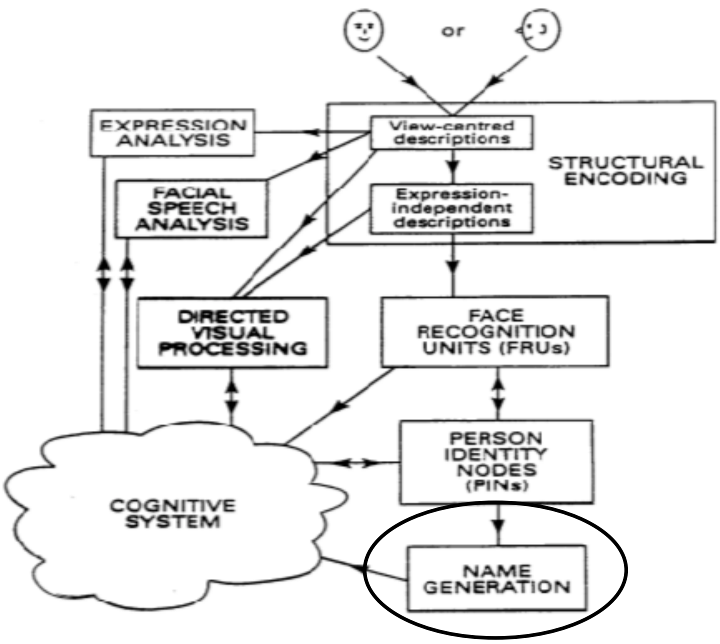
NAME GENERATION

- ■ What does this predict?

Expected behaviors

- Should find instances where people know biographical information but can't come up with their name . . .
  - Diary studies: this is a common problem.
  - Patients: some can tell you a lot about the person but are very poor at name retrieval.
  - Reaction times are faster for occupations decisions than names.

Bruce and Young (1986)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NAME GENERATION

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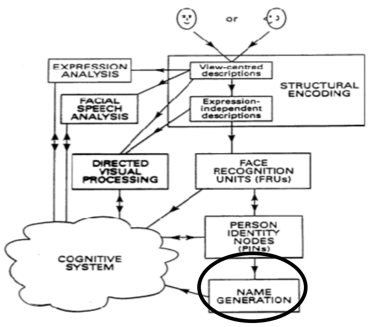
(6) Name generation

- Accessing the name is the last step.
- Note that the arrow only goes ONE direction (from PINs to name).

- What does this predict?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Expected behaviors

- Should never be able to find a case where someone can access a person’s name but knows nothing else about them.
  - Diary studies: no instances

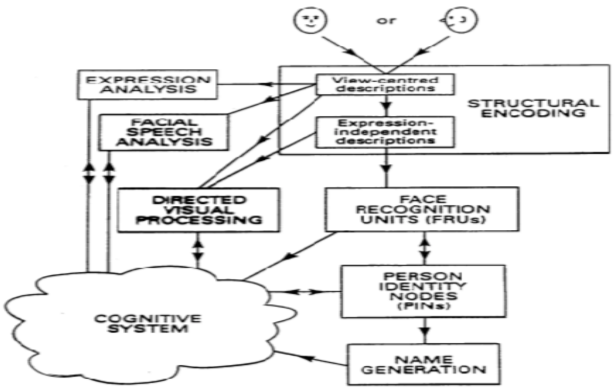
  - BUT . . . one patient is good at name retrieval but cannot get biographical information!

OOPS!

Remember that we need only one observation to disprove some part of a theory.

So, this theory has to be updated (and has been).

Bonus question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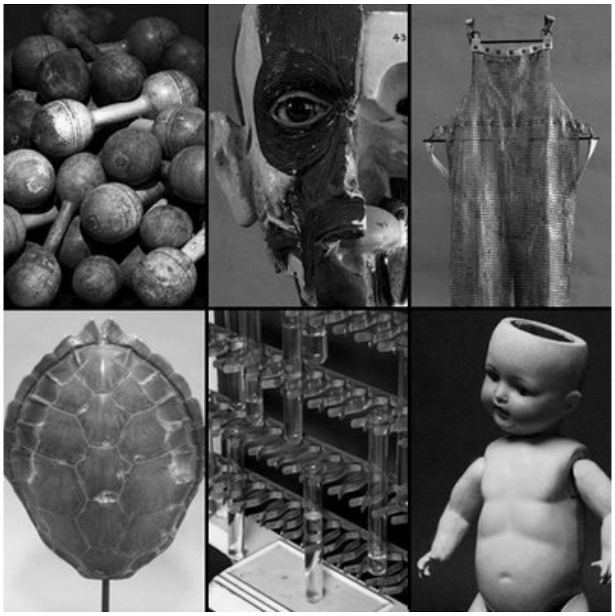
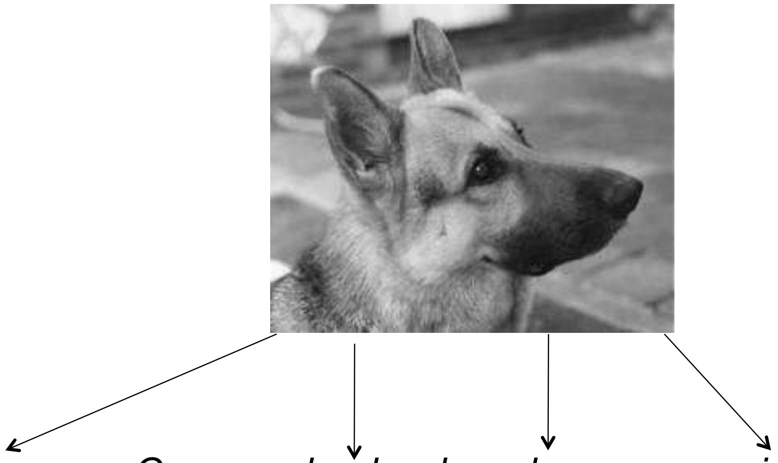
- Does this model allow top-down influences on face recognition?
- That is, according to this model, could expecting to see a particular actor in a movie make recognizing that actor’s face easier?

Categories



Multiple levels of recognition



Heidi	*German shepherd*	*dog*	*animal*
individual	subordinate	basic	superordinate

How is knowledge about objects represented and organized?

Classical View

-- definitions

Probabilistic View

-- similarity

Knowledge-based View

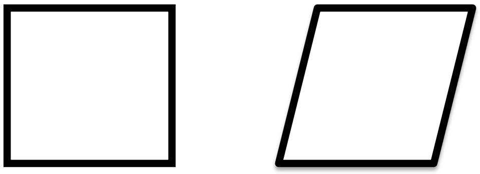
-- theories

CLASSICAL VIEW

- Objects are classified using properties that are necessary and sufficient.
  - If an instance has ALL these properties, it is a member of the category.
  - If not, it is not a member.
- UNITARY DESCRIPTION
  true of all members of the category

Classical View: Example

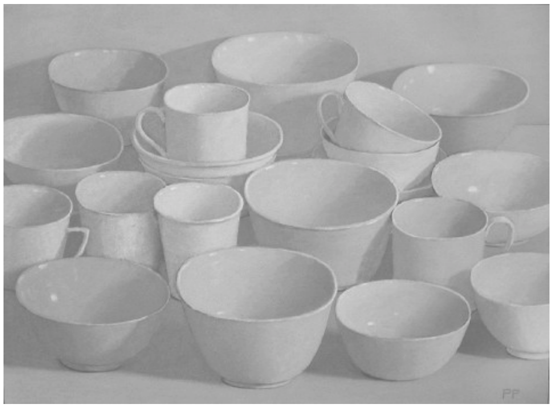
- What makes something a square?
- **Definitional properties**:
  - Closed figure
  - 4 sides
  - Equal sides
  - ~~Equal angles~~



Problems

- What are these defining features?
- ARE all instances equally "good"?

- Can we create a definition that will allow us to differentiate cups and bowls?



Typicality effects

- Some objects seem more representative of their category or type than others
  - Penguin is a bird.
  - Robin is a bird.

  - Coconut is a fruit.
  - Apple is a fruit.

PROBABILISTIC VIEW

- Representation that includes features *usually* true of category members.
- Classification determined by level of **similarity** to that representation.
- Types of representation:
  - Prototype
  - Exemplar

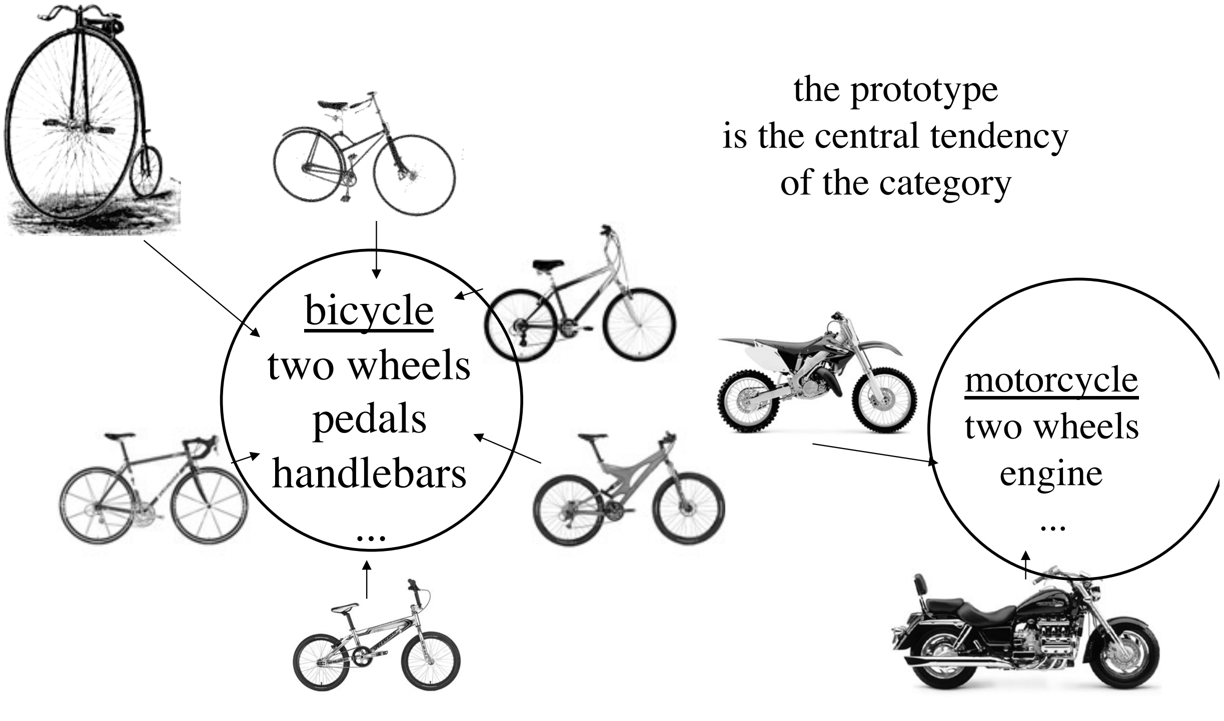
Prototype View

- Prototype: summary representation including all the typical properties.

UNITARY DESCRIPTION

true of all members of the category

Probabilistic View - Prototypes



the prototype
is the central tendency
of the category

bicycle
two wheels
pedals
handlebars
...

motorcycle
two wheels
engine
...

Family resemblance

Category members tend to share a set of features, each having some part of the set

BIRD
wings
flies
small
nests in trees
eats worms
...

Typicality (again)

- Bird properties:
  - Wings, flies, nests in trees, small, eats worms…
- Birds vary in how many of these properties they have
  - Robin -- all
  - Eagle -- some
  - Penguin -- few

Bird typicality ratings: high to low

BIRD
flies
small
nests in trees
eats worms
...

Robin
Sparrow
Bluejay
Parakeet
Pigeon
Eagle
Cardinal
Hawk
Parrot
Chicken
Duck
Goose

Typicality Effects:
- typicality ratings
- order of output
- ease of learning
- time to categorize

Prototype View: Summary

- Unitary representation
- Categorization based on similarity
- Probabilistic

Exemplar View

- Representation consists of separate descriptions of a large set of individual instances.
  - No unitary description
- Still similarity-based, but *flexible*: can use different information in different contexts

---

Probabilistic View - Exemplars

the concept is a collection
of known category members
(exemplars)

Exemplar view

- Object recognition can occur in different ways. Match object to…
  - Most similar exemplar
  - Set of most similar exemplars
  - All exemplars, weighted by similarity
- Can predict many prototype-like effects
- Can predict influences of frequency, context, correlation of features

---

Exemplar view

- Object recognition can be done by matching object to:
  - Most similar exemplar
  - Set of most similar exemplars
  - All exemplars, weighted by similarity
- Can predict many prototype-like effects
- Can predict influences of frequency, context, correlation of features

Example

- Which is more typical of birds:
  - Small or large?
- You see a bird who cannot sing
  - More likely to be small or large?
- How did you decide?

Problems with the exemplar view

- requires lots of memory and time to search
- what makes the exemplars within a category “go together”?
- is similarity enough?

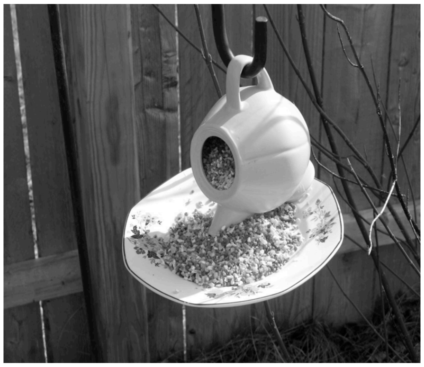
Similarity

Both prototype and exemplar views assume that *similarity* is the core of categorization.

Knowledge effects

- Suppose you took a raccoon:
  - Paint black
  - Paint white stripe on back
  - Operate: put “super smelly yucky stuff” in its tail
- What is it?
- Could it be a skunk?

Knowledge effects



- Suppose you took a coffee pot:
  - Punch holes in it, pull off spout
  - Hang from tree
  - Fill with bird seed
- What is it?
- Going beyond the similarity of observable features

Knowledge-based View

Similarity provides a good starting point, but…

Concepts are embedded in general knowledge.

Organized by “theories”:

- No longer just matching features

Thought question

After testing a number of prosopagnosics, a researcher finds that, although they recognize most types of objects with no trouble, in addition to their face processing problem they seem to have difficulty recognizing houses. What might you hypothesize from this finding about how houses are processed and about what behavioral effects you should observe for house recognition in normal participants?